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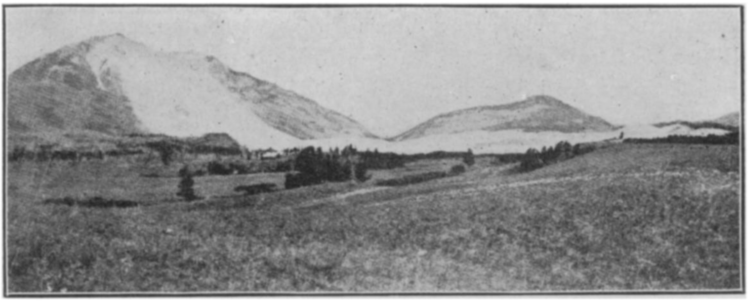
THE GREAT LANDSLIDE ON TURTLE MOUNTAIN.

The last annual *Report* of the Department of the Interior, Canada, contains the result of the examination made by the Geological Survey of the great landslide at Turtle Mountain on April 29, 1903. The Report was written by Messrs. R. G. McConnell and R. W. Brock. The facts here given are taken from it, together with two of the accompanying illustrations.

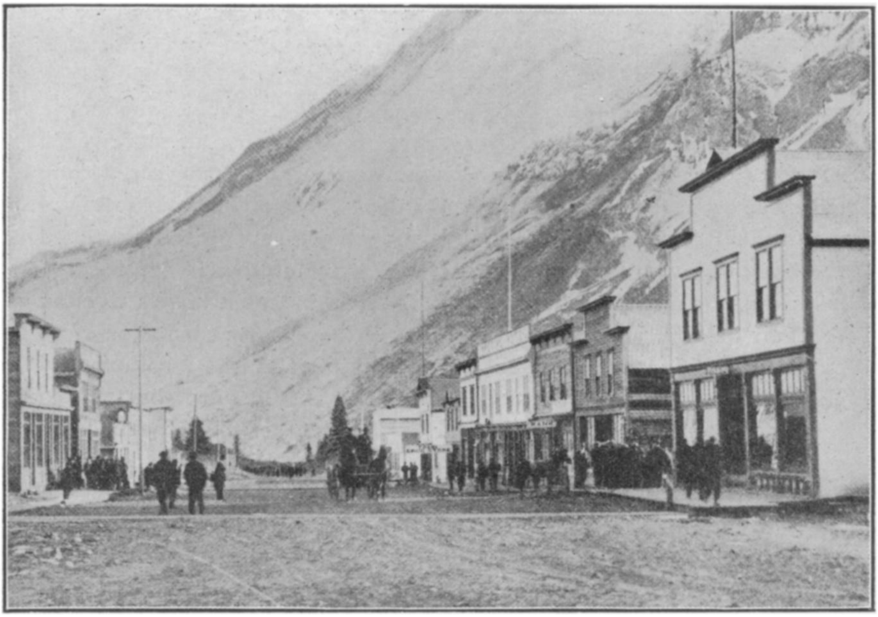
Turtle Mountain is a typical Rocky Mountain ridge, forming a part of the most easterly or front range of the mountains. It is built of westerly dipping beds, and its steep sides meet above in a sharp crest. The eastern face of the mountain overhangs the town of Frank, in Alberta. Turtle Mountain rises directly from the valley of Old Man River, a rapid stream, 40 to 50 feet in width. The mountain is built of Upper Palaeozoic limestones above and cretaceous shells and sandstones below.



VIEW OF THE SLIDE LOOKING NORTHWARD.

At dawn on April 29 a huge rock mass, nearly half a mile square, and probably 400 to 500 feet thick in places, suddenly broke loose from the east face of Turtle Mountain and precipitated itself with terrific violence into the valley beneath, overwhelming everything in its course. The great mass, urged forward by the momentum acquired in its descent, broke into innumerable fragments, ploughed through the bed of Old Man River, carrying both water and underlying sediments along with it and crossing the valley, a half mile wide, hurled itself against and up the opposite slope to a height of 400 feet. One of our pictures shows the denuded side of the mountain and the enormous stream of débris that was piled up across the valley. Blocks of limestone and shell now cover the valley to a depth of from 3 to about 150 feet over an area of 1.03 square miles.

The number of persons killed was given at about 70. The property destroyed included the plant at the mouth of the Canadian–American Coal and Coke Company's mine, the company's barn, 7 cottages at the east end of the town of Frank, half-a-dozen outlying houses, some camps and ranches, and a considerable number of horses and cattle. The persons occupying the houses in the track of the slide were all swept away with it and destroyed. The town of Frank lies on the farther side of the landslide, in the direction of the gap between the mountains. The second picture is a view of Dominion Avenue in this town, the part of which nearest the mountain was destroyed. A section of the landslide is shown at the farther end of the avenue.



DOMINION AVENUE, FRANK.

Only a part of the width of the slide is shown in this picture. The approaching wagon contains one of the injured persons.

The slide occurred about 4.10 A.M., when most of the inhabitants were asleep. The testimony of the residents threw little light on the character of the slide. They said the thud of the rock striking the valley bottom was distinctly felt, but the shock differed entirely from an earthquake movement. The noise of the slide was described as resembling that of steam escaping under high pressure.

The estimates of the eye-witnesses as to the time and rate of movement range all the way from twenty seconds to two minutes. It is probable that the time between the first crash and complete rest did not exceed 100 seconds, and may have been somewhat less. The horizontal distance from the summit of the mountain to the end of the slide is 9,916 feet, and following the slope about two and one-half miles. As those awakened by the roar had scarcely time to do more than rise from their beds before all was over, the rate of movement must have been extremely rapid.

Heim estimated that the blocks in the great slide at Elm in 1881 travelled about a mile and a half in from 10 to 30 seconds. The material in this slide leaped from a projecting shelf right across the valley, and the movement on this account was probably more rapid than in the case of the Turtle Mountain slide. The separated rock mass seems to have been shattered by impact against the side of the mountain during its descent, and, probably long before it reached the bottom, into myriads of fragments, some of which were doubtless flung far out into the valley. The blocks must have travelled to their destination largely by a succession of great leaps or ricochets, probably accompanied by a certain amount of rolling and sliding. On the level flats the movement was onward, but with a tendency towards lateral dilation; but when terraces or other elevations were encountered a portion of the material was deflected and flowed along the the line of obstruction.

The slide rock consisted mostly of angular fragments of limestone, ranging in size from grains up to great blocks forty feet in length. Large rocks were common everywhere, and especially along the central portion of the slide. The greater part of the débris consisted of fragments from 3 to 20 feet in diameter. Much soft mud was derived from the bed of Old Man River, parts of which were scooped out probably down to the bed rock.

The surface of the slide was singularly uneven. The rocks were heaped up into mounds and short interlacing ridges enclosing hollows, somewhat resembling a terminal moraine. Peculiar conical mounds built of loose rocks up to 3 feet in diameter were observed at several points. The larger ridges were due in most cases to elevations in the old surface. A well-marked depression extended across the slide, due, apparently, to the protection of a rocky knoll to the south, which flung the greater part of the material across it.

The valley, of course, was completely changed, as the former flats, and even terraces, were buried deeply under a mass of unassorted material. Old Man River was dammed at the lower part of the slide, and the channel above it became occupied by a chain of small lakes, with a depth of from 20 to 35 feet. Gold Creek was deflected to the west. The average depth of the whole of the slide rock amounted to about 45 feet. The contents of the mass, assuming 45 feet as the thickness, were about 47,857,820 cubic yards. This represents, approximately, 36,000,000 cubic yards of solid rock, equal in weight to about 80,300,000 tons. A rough estimate of the size of the mass which broke away, obtained by comparison of the old and new contour of the mountain itself, is somewhat greater, amounting to about 40,702,000 cubic yards, or 90,796,000 tons. No slide at all approaching it in size had hitherto been recorded in any part of the Canadian Rockies. Destructive landslides are frequent in the Alps, but none of those recorded have equalled this slide in extent.

The landslide was a breaking away of the mountain mass across the bedding planes. The mountain was ripe for such a catastrophe. The steep slopes, the shattered and fractured nature of the rocks, coupled with unusually heavy precipitation, are causes quite sufficient to have produced it. There is reason to believe, also, that the great chambers, 130 feet long, 250 to 400 feet high, and 15 feet wide, which had been dug in the coal mine directly at the foot of the mountain, must have weakened it.

The huge mass was in a state of unstable equilibrium, possessed a weak base, and was thoroughly traversed by fissure and jointing planes, in which water and frost were continuously at work, removing one by one the supports which held it in place. The heavy precipitation of the last few years accelerated this process, and recent earthquake tremors, no doubt, hastened the final disruption. The heavy frost on the morning of the slide, which followed hot days, appears to have been the force that severed the last thread and precipitated the unbalanced mass.

The zone surrounding the cavity left by the mass which broke away is excessively fractured and is doomed to fall. The north peak and shoulder overhanging the town threaten it with destruction, and it is recommended that Frank be moved a short distance up the valley beyond the reach of danger.